CLAIMS

What is claimed is:

1. A compensation system programmed to mitigate errors associated with a conversion system, the compensation system comprising:

a digital error model programmed to provide an emulated error signal as a function of an input signal that is quantized in a predetermined number of one or more levels, the digital error model having parameters adaptively adjusted based on a signal of the conversion system to emulate error characteristics associated with at least a portion of the conversion system.

2. The compensation system of claim 1, the parameters of the digital error model are adjusted based on inband frequency content of the signal of the conversion system.

3. The compensation system of claim 2, the signal of the conversion system is an output signal provided by the conversion system.

4. The compensation system of claim 1, the parameters of the digital error model are adapted to converge to respective values that substantially minimize errors in an output signal of the conversion system over a plurality of iterations.

5. The compensation system of claim 1, the digital error model comprising:

a splitter operative to divide the input signal into plural intermediate signals;

a multi-input single output system that employs the parameters of the digital error model to combine the intermediate signals for providing the emulated error signal.

6. The compensation system of claim 5, the multi input single output system further comprising:

a weighting component that applies weighting to the intermediate signals based on the parameters of the digital error model to provide weighted intermediate signals, and

a linear multi-input single output system that combines weighted intermediate signals to provide the emulated error signal.

7. The compensation system of claim 6, wherein each of the parameters are applied to a respective one of the intermediate signals to provide the weighted intermediate signals.

8. The compensation system of claim 5, the digital error model further comprising an error coefficient vector that includes error coefficients associated with each of the predetermined number of levels, the error coefficients being adapted to converge to respective values that mitigate errors in an output signal of the conversion system.

9. The compensation system of claim 1, further comprising a calibration system that calibrates the parameters of the digital error model in a calibration mode based on content of an output signal of the conversion system in response to a calibration signal provided to the conversion system.

10. The compensation system of claim 9, the calibration system further comprising an estimator operative to minimize error in the output signal by adjusting the parameters of the digital error model based on at least one of the input signal and the output signal of the conversion system.

11. The compensation system of claim 9, the calibration signal being provided substantially free of in-band frequencies, such that the output signal of the conversion system corresponds to a residual error signal that minimizes as the digital error model better approximates error characteristics of the conversion system.

12. The compensation system of claim 11, further comprising a filter that filters the output signal of the conversion system to provide the residual error signal substantially free of out-of-band frequencies.

13. The compensation system of claim 1 in combination with a digital-to-analog converter (DAC) that forms part of the conversion system, the combination comprising:

the DAC coupled to receive the input signal that is quantized in the predetermined number of levels and to convert the input signal to a corresponding analog output signal, the error characteristics being error characteristics associated with the DAC.

14. The combination of claim 13, further comprising:

a noise and error shaping filter that receives a digital signal and provides a filtered digital signal for conversion into the corresponding analog signal;

a quantizer that provides a quantized signal to the DAC based on the filtered digital signal, the quantized signal defining the input signal to the DAC; and

the digital error model providing the emulated error signal to the noise and error shaping module as a function of the quantized signal.

15. The combination of claim 13, further comprising a calibration system that calibrates the parameters of the digital error model during a calibration mode based on the corresponding analog output signal.

16. The combination of claim 13, further comprising:

an analog filter that substantially removes out-of-band frequencies and quantization noise from the corresponding analog output signal, and provides a filtered analog signal;

an analog-to-digital converter that converts the filtered analog signal into a corresponding digital representation of the filtered signal; and

a calibration system that calibrates the parameters of the digital error model as a function of the digital representation of the filtered signal so as to mitigate errors in the digital representation of the filtered signal.

17. The combination of claim 13, the DAC comprising a binary weighted, multi-bit DAC that includes at least two capacitors, the parameters of the digital error model characterizing mismatch errors in the at least two capacitors.

18. The compensation system of claim 1 in combination with an analog-to-digital converter (ADC) system that forms part of the conversion system, the combination comprising:

the ADC system comprising:

a noise-shaping filter that receives an analog input signal and provides a filtered representation of the analog input signal;

an ADC that converts the filtered representation of the analog input signal to a corresponding digital output signal, the digital output signal defines the input signal having the predetermined number of levels; and

a digital-to-analog converter (DAC) that converts the digital output signal of the ADC to a corresponding analog representation thereof that is provided to the noise shaping filter; and

the model being calibrated to provide the emulated error signal as a function of the corresponding digital output signal of the ADC to mitigate errors in the digital output signal, the error characteristics being error characteristics associated with the DAC.

19. The combination of claim 18, further comprising:

a digital filter that substantially removes out-of-band frequencies in the corresponding digital output signal of the ADC, and the digital filter provides a filtered digital signal; and

a calibration system that calibrates the parameters of the digital error model as a function of the filtered digital signal by adaptively adjusting the parameters of the model to mitigate errors in the filtered digital signal.

20. The combination of claim 19, further comprising a calibration signal provided to the conversion system substantially free of in-band frequencies, such that the filtered digital signal from the digital filter corresponds to a residual error signal that minimizes as the model better approximates the error characteristics of the DAC.

21. A conversion system comprising:

a noise shaping filter that provides a noise-shaped signal for conversion to a corresponding output signal of the conversion system;

a model operative to introduce a compensation error signal into the conversion system based on a digital representation of the noise-shaped signal having plural quantization levels; and

a calibration system that adaptively programs parameters of the model during a calibration mode in which a calibration signal is provided to the conversion system, the calibration system adapting the parameters of model in the calibration mode to emulate error characteristics associated with at least a portion of the conversion system by adjusting parameters of the model to mitigate residual error in the output signal of the conversion system.

22. The system of claim 21, the calibration system further comprising an estimator operative to minimize error in the output signal by adjusting the parameters of the model based on at least one of the digital representation of the noise-shaped signal and the output signal of the conversion system.

23. The system of claim 21, the calibration signal being provided substantially free of in-band frequencies, such that the output signal of the conversion system corresponds to a residual error signal that minimizes as the model better approximates the error characteristics during the calibration mode.

24. The system of claim 23, further comprising a filter that filters the output signal of the conversion system to provide the residual error signal substantially free of out-of-band frequencies.

25. The conversion system of claim 21 defining an analog-to-digital converter (ADC) system, the ADC system further comprising:

an ADC that converts the noise-shaped signal to a corresponding digital output signal, the digital output signal defines the digital representation of the noise-shaped signal;

a digital-to-analog converter (DAC) that converts the digital output signal of the ADC to a corresponding analog representation thereof that is provided to the noise shaping filter; and

the model being calibrated to provide the emulated error signal as a function of the digital output signal of the ADC to mitigate errors in the digital output signal, the error characteristics being error characteristics associated with the DAC.

26. The conversion system of claim 21 defining a digital-to-analog converter (DAC) system, the DAC system further comprising:

a quantizer that provides a quantized signal based on the noise-shaped signal, the quantized signal defining the digital representation of the noise-shaped signal;

a DAC that converts the quantized signal to a corresponding analog signal that defines the output signal of the conversion system, the error characteristics being error characteristics associated with the DAC; and

the error model providing the emulated error signal to the noise shaping filter as a function of the quantized signal.

27. A conversion system comprising:

means for converting an input signal from one form of signal content to an output signal having a different form of signal content;

means for providing an emulated error signal into the conversion system as a function of an intermediate conversion signal having plural levels; and

means for adaptively programming parameters of the means for providing during a calibration mode by adapting parameters of a model based on a signal of the means for converting to enable the model to emulate error characteristics associated with at least a portion of the means for converting for mitigating residual error in the output signal thereof.

28. The system of claim 27, further comprising:

means for providing a calibration signal to the conversion system during at least a substantial portion of the calibration mode, the calibration signal being provided substantially free of in-band frequencies; and

means for filtering the output signal to provide a filtered signal that is substantially free of out-of-band frequencies;

the means for adaptively programming adapting the parameters of the model based on the filtered signal during the calibration mode, the filtered signal corresponding to a residual error signal that minimizes as the model better approximates the error characteristics of the conversion system.

29. A method for generating an error model operative to mitigate errors associated with at least a portion of a conversion system, the method comprising:

supplying a calibration signal to the conversion system;

providing an emulated error signal to the conversion system as a function of an intermediate signal generated based on the calibration signal and having a predetermined number of levels;

adaptively calibrating parameters of the model based on an output signal of the conversion system to minimize error in the output signal, which error is associated with at least a portion of the conversion system; and

storing the model when sufficiently calibrated.

30. The method of claim 29, the conversion system including a digital-to-analog converter (DAC) coupled to receive the intermediate signal, the calibration further comprising adaptively calibrating the parameters of the model to emulate error associated with the DAC.

31. The method of claim 29, the calibration signal being substantially free of in-band frequencies, the method further comprising filtering the output signal of the conversion system to provide a filtered output signal that defines residual error in the conversion system associated with the at least a portion of the conversion system, the calibration further comprising adaptively calibrating the parameters to minimize the residual error.